PATENT ABSTRACTS OF JAPAN

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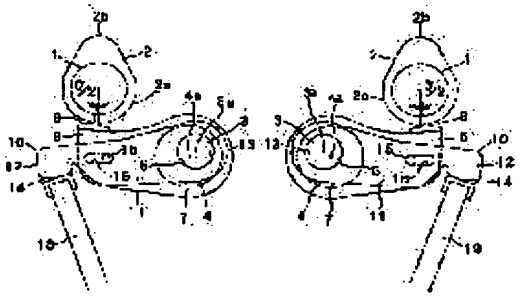
(54) VARIABLE VALVE SYSTEM MECHANISM

(57)Abstract:
PROBLEM TO BE SOLVED: To enhance various characteristics in an entire revolution area by executing precise control while an overlap angle and the quantity of lift are being changed continuously or stepwise when an internal combustion engine is rotated from its low revolution speed up to high revolution speed, and make a valve system mechanism simpler and more compact.
SOLUTION: An eccentric shaft part 4 is provided for one part of a rocker shaft 3 while its axial center is one-sided. A first arm 6 is rotatably supported by the eccentric shaft part 4 in such a way that it can be rocked, and it is pressed by a cam 2 so as to be rocked. A second arm 10 is rotatably supported by the rocker shaft 3 in such a way that it can be rocked, concurrently, the first arm 6 is engaged in such a way that it can be relatively displaced, and receiving the rocking motion of the first arm 6, and thereby rocking allow valves 18 and 19 to be opened/closed. An arm displacement device allows the eccentric shaft part 4 to be rotated continuously or stepwise in response to an operating condition, and also allows the first arm 6 to be displaced to the circumferential direction.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] A rocker shaft and the eccentric shaft section which shifted the axial center to said a part of rocker shaft, and was prepared in it, While it is supported to revolve by said eccentric shaft section rockable and being supported to revolve by the first arm which it is pressed by the cam and rocked, and said rocker shaft rockable The second arm which opens and closes a bulb when said first arm is engaged possible [a relative displacement] and rocks in response to the splash of said first arm, the arm which rotates said eccentric shaft section continuously or gradually according to operation situations, such as an internal combustion engine's rotational frequency, and it has [arm], and carries out the variation rate of said first arm to the circumferencial direction of said cam -- a variation rate -- the adjustable valve gear equipped with equipment.
[Claim 2] The adjustable valve gear according to claim 1 by fitting of the long hole and engagement pin by which engagement on said first arm and second arm was prepared relatively [arm / said / first arm and second arm].
[Claim 3] The adjustable valve gear according to claim 1 by the contact to the roller and contact side in which engagement on said first arm and second arm was prepared relatively [arm / said / first arm and second arm].
[Claim 4] Said second arm is an adjustable valve gear according to claim 1, 2, or 3 which is the swing arm which the end section was supported to revolve by the rocker shaft rockable, and the center section engaged with said first arm, and equipped the other end with the bulb press section.
[Claim 5] Said second arm is an adjustable valve gear according to claim 1, 2, or 3 which is the rocker arm which the center section was supported to revolve by the rocker shaft rockable, and the end section engaged with said first arm, and equipped the other end with the bulb press section.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the adjustable valve gear to which an overlap angle and the amount of lifts are changed from the time of a low revolution of an internal combustion engine continuously or gradually till a high revolution.
[0002]
[Description of the Prior Art] Conventionally, the valve gear which changes valve timing and the amount of lifts to two steps is variously known for the time of a low revolution of an internal combustion engine and a high revolution. For example, the cam for a low revolution with small valve-opening working angle and amount of lifts and the cam for a high revolution with large valve-opening working angle and amount of lifts are changed, and there is an adjustable valve gear of a type which makes a swing arm rock, respectively. According to this adjustable valve gear, compared with a general valve gear, many properties, such as an air cleanliness class of an output, torque, fuel consumption, and exhaust gas, improve considerably.
[0003]
[Problem(s) to be Solved by the Invention] However, the following technical problems remained also in this adjustable valve gear.
** Since valve timing or the amount of lifts was only changed to two steps in the time of a low revolution and a high revolution, the precise control according to an internal combustion engine's operation situation was difficult. Moreover, the trough might be generated in the torque characteristic on the change point with the time of a low revolution and a high revolution.
[0004] ** Since two cams were needed to one bulb, structure became complicated and there was a problem that miniaturization was difficult. Moreover, since the type to which a pin is moved with high oil pressure as a change device was in use, did not change smoothly by one actuation, the allophone occurred at the time of a change, or the part was worn out, and there was a problem that precision and dependability were missing. Furthermore, in order to carry out change responsibility early, there was also a problem that a high hydraulic power unit was needed.
[0005] The object of this invention solves the above-mentioned technical problem. Then, the time of a low revolution of an internal combustion engine to the time of a high revolution An overlap angle and the amount of lifts are changed continuously or gradually. While being able to perform precise control according to an internal combustion engine's operation situation, being able to have and being able to raise many properties, such as the clean nature of an output, torque, fuel consumption, and exhaust gas, over all revolution regions to the maximum extent It is in offering the new adjustable valve gear which can be made to perform said change smoothly and calmly, it can make it possible to manage with one cam to one bulb further, can make structure simple, and can attain miniaturization.
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned object, the adjustable valve gear of this invention While being supported to revolve by a rocker shaft, the eccentric shaft section which shifted the axial center to a part of rocker shaft, and was prepared in it, the first arm which it is supported to revolve by the eccentric shaft section rockable, it is pressed by the cam, and is rocked, and the rocker shaft rockable The second arm which opens and closes a bulb when the first arm is engaged possible [a relative displacement] and rocks in response to the splash of the first arm, the arm which rotates the eccentric shaft section continuously or gradually according to operation situations, such as an internal combustion engine's rotational frequency, and it has [arm], and carries out the variation rate of the first arm to the circumferencial direction of a cam -- a variation rate -- it is characterized by having equipment.

[0007] Engagement on the first arm and the second arm is not limited to a specific means, but can illustrate the following means.
**) Engagement by fitting of the long hole and engagement pin which were prepared relatively [arm / first arm and / second]. A "relative target" means that a long hole is prepared in either of the first arm and the second arm, and an engagement pin should just be prepared in another side.
**) Engagement by the contact to the roller and contact side which were established relatively [arm / first arm and / second]. A "relative target" means that a roller is formed in either of the first arm and the second arm, and a contact side should just be established in another side.
[0008] Although you may make it change to two steps when carrying out the variation rate of the first arm gradually with arm displacement equipment, it is desirable to make three or more steps carry out a variation rate. It is carrying out the variation rate of the first arm continuously still more preferably. Arm displacement equipment is not limited to specific structure, but can illustrate the thing using oil pressure, electromagnetic force, etc.
[0009] The following can be illustrated as the second arm.
1) The swing arm which the end section was supported to revolve by the rocker shaft rockable, and the center section engaged with said first arm, and equipped the other end with the bulb press section.
2) The rocker arm which the center section was supported to revolve by the rocker shaft rockable, and the end section engaged with said first arm, and equipped the other end with the bulb press section.
[0010] In addition, although the adjustable valve gear of this invention is also applicable to either an intake valve or an exhaust air bulb, applying to both is desirable.
[0011]
[Embodiment of the Invention] Hereafter, the example of an operation gestalt of the adjustable valve gear which carried out this invention is explained with reference to a drawing.
[0012] First, drawing 1 - drawing 6 show the adjustable valve gear of the first operation gestalt. As this adjustable valve gear is shown in drawing 1 and drawing 2 R> 2, it is applied to the both sides of an inspired air flow path (right-hand side) and an exhaust side (left-hand side), and the structure of both sides is bilateral symmetry. Therefore, most following structure explanation is common in the adjustable valve gear of both sides. In addition, drawing 3 - drawing 5 show only the adjustable valve gear of an exhaust side for convenience.
[0013] a cam shaft 1 -- base round part 2a of a predetermined cam profile, and a nose -- the cam 2 which consists of section 2b is formed. The eccentric eccentric ring-like shaft section 4 is extrapolated by a part of rocker shaft 3 allotted to the slanting lower part of a cam shaft 1, and the key 5 pressed fit in both the key ways of a rocker shaft 3 and the eccentric shaft section 4 is fixed. Axial center 3a of a rocker shaft 3 and axial center 4a of the eccentric shaft section 4 are shifted.
[0014] The first arm 6 which it is pressed by the cam 2 and rocked is supported to revolve rockable by the eccentric shaft section 4. The first arm 6 was supported to revolve by the eccentric shaft section 4 in the insertion hole 7 formed in the end section, and is equipped with the hard pad 8 with which a cam 2 ****s on the top face of the other end.
[0015] the both sides which sandwich the eccentric shaft section 4 of a rocker shaft 3 -- two forks -- the second arm 10 really formed in pi mold from the arm body 11 and the connection section 12 of a ** is supported to revolve rockable. The second arm 10 is a swing arm which it was supported to revolve by the rocker shaft 3 in the insertion hole 13 formed in the end section of the arm body 11, and the center section engaged with the first arm 6, and equipped the connection section 12 of the other end with the two bulb press sections 14.
[0016] The first arm 6 is engaging with the center section of the arm body 11 possible [a relative displacement]. For this reason, the second arm 10 is rocked in response to the splash of the first arm 6, and two exhaust air bulbs 18 or two intake valves 19 are opened and closed simultaneously. Engagement on the first arm 6 and the second arm 10 is engagement by the center section of the engagement pin 15 by which insertion support was carried out fitting into both the arm body 11 of the second arm 10 possible [the slide to the long hole 16 installed through the pars intermedia of the first arm 6]. This slide permits the variation rate of the first arm 6.
[0017] the arm which makes a rocker shaft 3 rotate the eccentric shaft section 4 continuously or gradually with a rocker shaft 3 according to operation situations, such as an internal combustion engine's rotational frequency, and it has [arm] in it, and carries out the variation rate of the first arm 6 to the circumferencial direction of a cam 2 -- a variation rate -- equipment 17 is connected. Drawing 5 is the explanatory view showing the locus which a pad 8 displaces to the circumferencial direction of a cam 2 when the first arm 6

displaces, and a pad 8 is displaced in the range of theta angle. Arm displacement equipment 17 consists of a helical spline device and an actuator which used oil pressure (it is graphic display abbreviation for details), and is controlled by control units, such as a microcomputer, based on the detection value from an internal combustion engine's revolution sensor, an accelerator opening sensor, etc.

[0018] The adjustable valve gear constituted as mentioned above acts as follows. first, as shown in drawing 1 at the time of a low revolution of an internal combustion engine, axial center 4a of the eccentric shaft section 4 comes to a bulb side from axial center 3a of a rocker shaft 3 -- as -- an arm -- a variation rate -- equipment 17 rotates a rocker shaft 3 and the eccentric shaft section 4, and carries out the variation rate of the first arm 6 to a bulb side. In addition, in order to obtain the displacement locus of the above pads 8, it is desirable that it attaches an include angle to a pad 8 from axial center 3a as axial center 4a comes to the slant bottom.

[0019] Since the cam 2 of both sides is left-handed rotation in the case of this operation gestalt, if the first arm 6 of an exhaust side (left-hand side) displaces to a bulb side, a pad 8 is located in the advancing side of a cam 2, and a pad 8 is located in the delay side of a cam 2 if the first arm 6 of an inspired air flow path (right-hand side) displaces to a bulb side. Moreover, the distance from axial center 3a of a rocker shaft 3 to the center of a pad 8 becomes long, and since the ratio (arm ratio) of the distance from axial center 3a of a rocker shaft 3 to this distance to the bulb press section 14 becomes small, the amount of lifts of the bulbs 18 and 19 by the second arm 10 becomes small. Therefore, as shown in the curve L of drawing 6 , the exhaust air bulb 18 and an intake valve 19 are opened and closed in a small overlap angle and the amount of lifts, stabilize an idling, and raise fuel consumption.

[0020] moreover, as shown in drawing 2 at the time of a high revolution of an internal combustion engine, axial center 4a of the eccentric shaft section 4 comes to an anti-bulb side from axial center 3a of a rocker shaft 3 -- as -- an arm -- a variation rate -- equipment 17 rotates a rocker shaft 3 and the eccentric shaft section 4, and carries out the variation rate of the first arm 6 to an anti-bulb side. In addition, in order to obtain the displacement locus of the above pads 8, it is desirable that it attaches an include angle to a pad 8 from axial center 3a as axial center 4a comes to a slant upside.

[0021] If the first arm 6 of an exhaust side displaces to an anti-bulb side, a pad 8 is located in the delay side of a cam 2, and a pad 8 is located in the advancing side of a cam 2 if the first arm 6 of an inspired air flow path displaces to an anti-bulb side. Moreover, the distance from axial center 3a of a rocker shaft 3 to the center of a pad 8 becomes short, and since the ratio (arm ratio) of the distance from axial center 3a of a rocker shaft 3 to this distance to the bulb press section 14 becomes large, the amount of lifts of the bulbs 18 and 19 by the second arm 10 becomes large. Therefore, the exhaust air bulb 18 and an intake valve 19 are opened and closed in a large overlap angle and the amount of lifts, and as shown in the curve H of drawing 6 , they heighten an output.

[0022] and it results from the time of the above-mentioned low revolution at the time of a high revolution -- on the way -- alike -- also setting -- operation situations, such as a rotational frequency and an accelerator opening, -- responding -- an arm -- a variation rate -- equipment 17 rotates continuously a rocker shaft 3 and the eccentric shaft section 4, and carries out the variation rate of the first arm 6. Therefore, the exhaust air bulb 18 and an intake valve 19 open and close in an in-between overlap angle and the amount of lifts, and as shown in the curve M of drawing 6 , they generate the output according to an operation situation.

[0023] As mentioned above, according to the adjustable valve gear of the first operation gestalt, the time of a low revolution of an internal combustion engine to the time of a high revolution can change an overlap angle and the amount of lifts continuously, can perform precise control according to an internal combustion engine's operation situation, can have, and can raise many properties, such as the clean nature of an output, torque, fuel consumption, and exhaust gas, over all revolution regions to the maximum extent. Especially, torque increases over all revolution regions and does not produce a trough, either. Moreover, fuel consumption also improves. Moreover, with the variation rate of the first arm 6, said change can be made to perform smoothly and calmly, further, it can make it possible to end with one cam to one bulb (this operation gestalt two), structure can be made simple, and miniaturization can be attained.

[0024] Next, drawing 7 - drawing 10 show the adjustable valve gear of the second operation gestalt. This adjustable valve gear is different from the first operation gestalt only in the point which transposed said pad 8 to the roller 24, and the point which transposed fitting of said long hole 16 and engagement pin 15 to the contact to a roller 25 and the contact side 22.

[0025] namely, the lower part of the second arm 10 -- two forks -- the roller receptacle section 21 which connects between the arm bodies 11 of a ** is formed, and the top face of this roller receptacle section 21 is the contact side 22 which curves gently. An attaching hole 23 is installed in the vertical direction by the

other end of the first arm 6, the roller 25 of the bottom which contacts the roller 24 and the contact side 22 of the upside to which a cam 2 contacts this attaching hole 23 is arranged, and each rollers 24 and 25 are fixed to revolve by the side-attachment-wall section of the first arm 6 pivotable. When the lower roller 25 contacts the contact side 22 possible [rolling], the first arm 6 is engaging with the center section of the second arm 10 possible [a relative displacement]. Others are as common as the first operation gestalt, attach a sign common to drawing 7 - drawing 10 , and omit explanation.

[0026] The adjustable valve gear of this operation gestalt acts like the first operation gestalt fundamentally. First, as shown in drawing 7 at the time of a low revolution of an internal combustion engine, the variation rate of the first arm 6 is carried out to a bulb side. Thereby, as shown in the curve L of drawing 6 , the exhaust air bulb 18 and an intake valve 19 are opened and closed in a small overlap angle and the amount of lifts, stabilize an idling, and raise fuel consumption.

[0027] Moreover, as shown in drawing 8 at the time of a high revolution of an internal combustion engine, the variation rate of the first arm 6 is carried out to an anti-bulb side. Thereby, the exhaust air bulb 18 and an intake valve 19 are opened and closed in a large overlap angle and the amount of lifts, and as shown in the curve H of drawing 6 , they heighten an output.

[0028] And the exhaust air bulb 18 and an intake valve 19 open and close in an in-between overlap angle and the amount of lifts, and while resulting from the time of the above-mentioned low revolution at the time of a high revolution, as shown in the curve M of drawing 6 , they generate the output according to an operation situation.

[0029] Therefore, the same effectiveness as the first operation gestalt is acquired also according to this operation gestalt. And since the lower roller 25 rolls in contact with the contact side 22 while a cam 2 contacts the roller 24 of a pivotable upside, the friction loss in both the contact section can be reduced, and said variation rate can be performed smoothly.

[0030] In addition, this invention is not limited to the configuration of said operation gestalt, and can also be changed and materialized in the range which does not deviate from the meaning of invention as follows.

(1) Carry out the variation rate of the first arm 6 gradually.

(2) Change suitably the method of the configuration of arm displacement equipment 17, or control.

(3) As the second arm, replace with a swing arm and adopt a rocker arm.

[0031]

[Effect of the Invention] Since the adjustable valve gear of this invention is constituted as above-mentioned, the time of a low revolution of an internal combustion engine to the time of a high revolution can change an overlap angle and the amount of lifts continuously or gradually, can perform precise control according to an internal combustion engine's operation situation, can have it, and it can raise many properties, such as the clean nature of an output, torque, fuel consumption, and exhaust gas, over all revolution regions to the maximum extent. Moreover, said change can be made to perform smoothly and calmly, and the outstanding effectiveness that it can make it possible to end with one cam to one bulb, structure can be made simple, and miniaturization can be attained is further done so.

[Translation done.]

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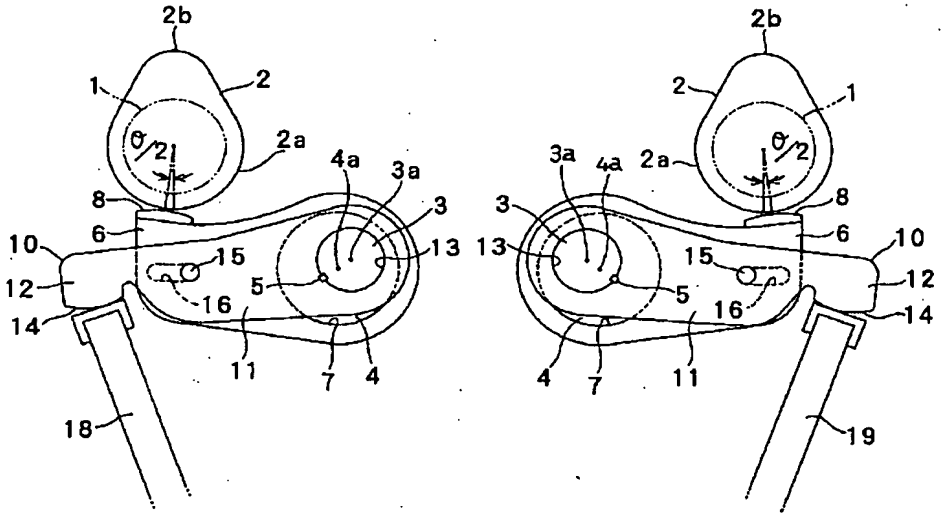
DRAWINGS

[Drawing 1]



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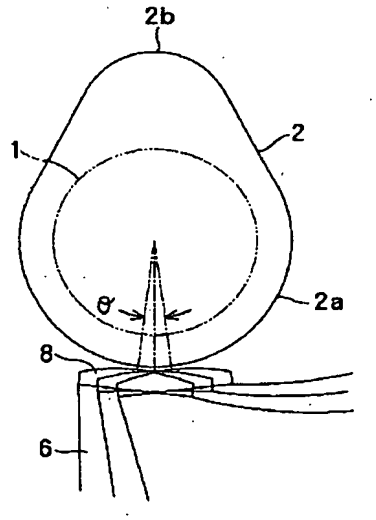

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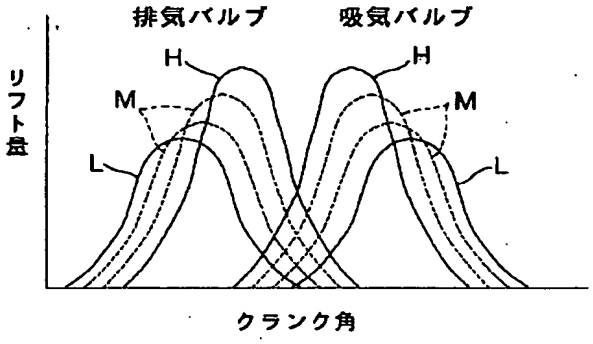

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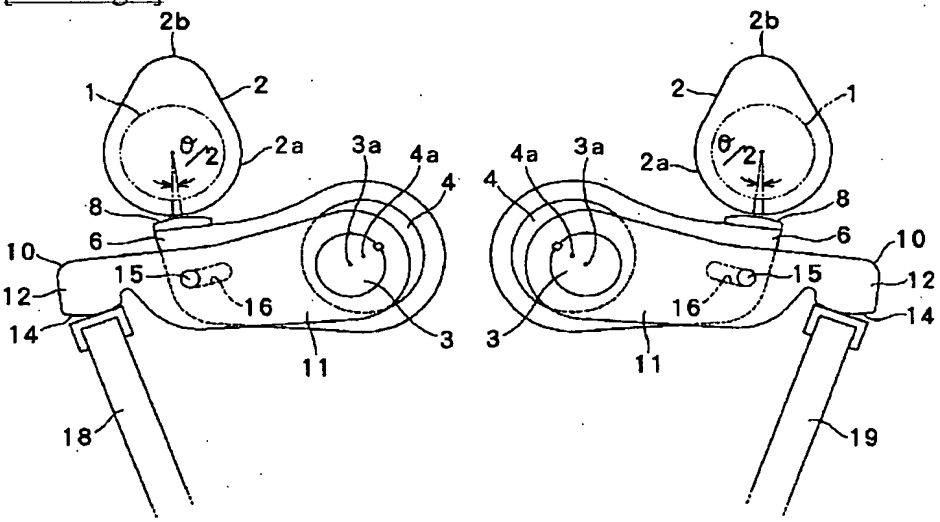

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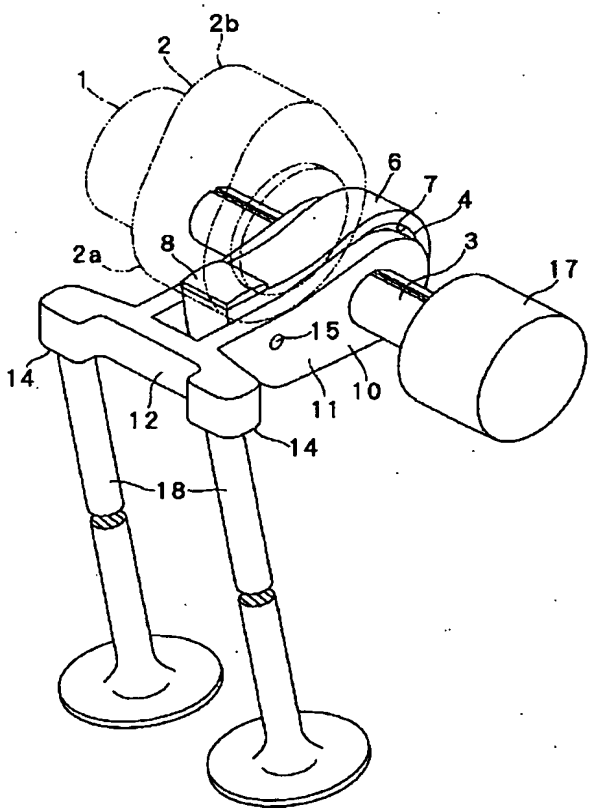

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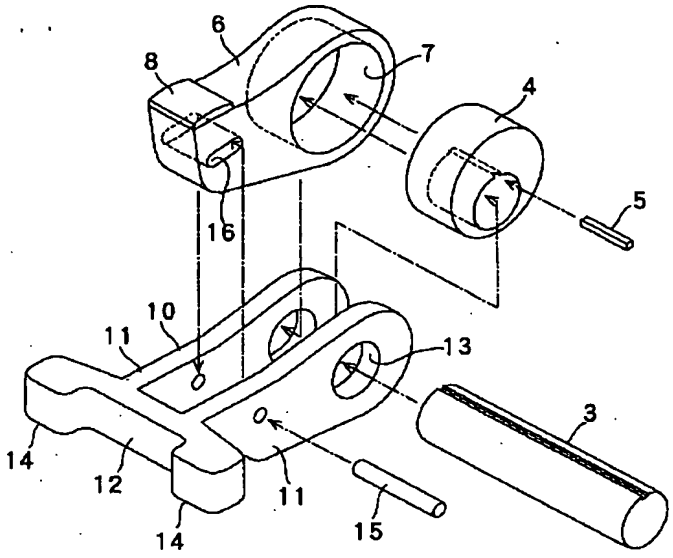

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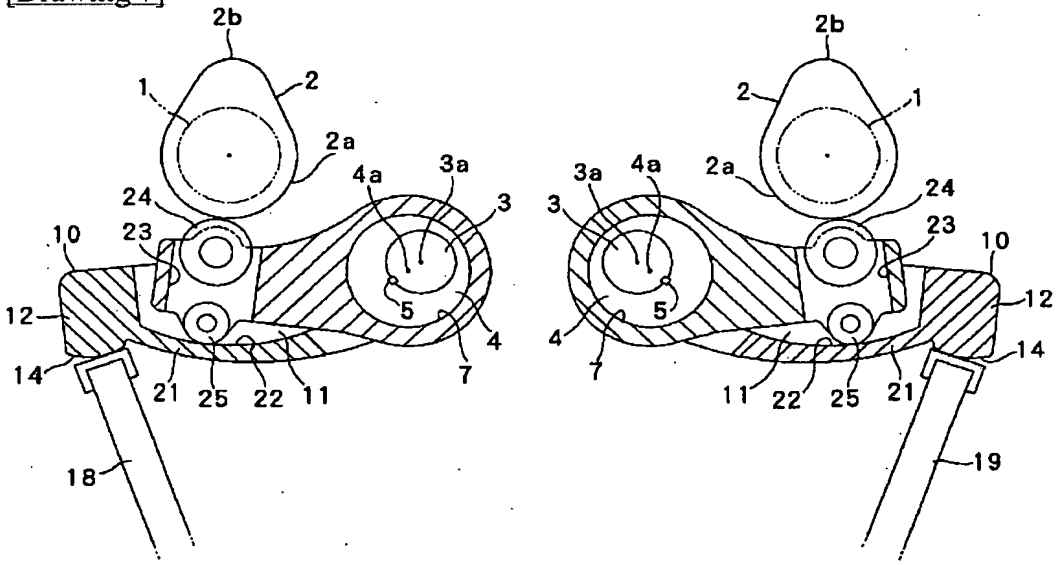

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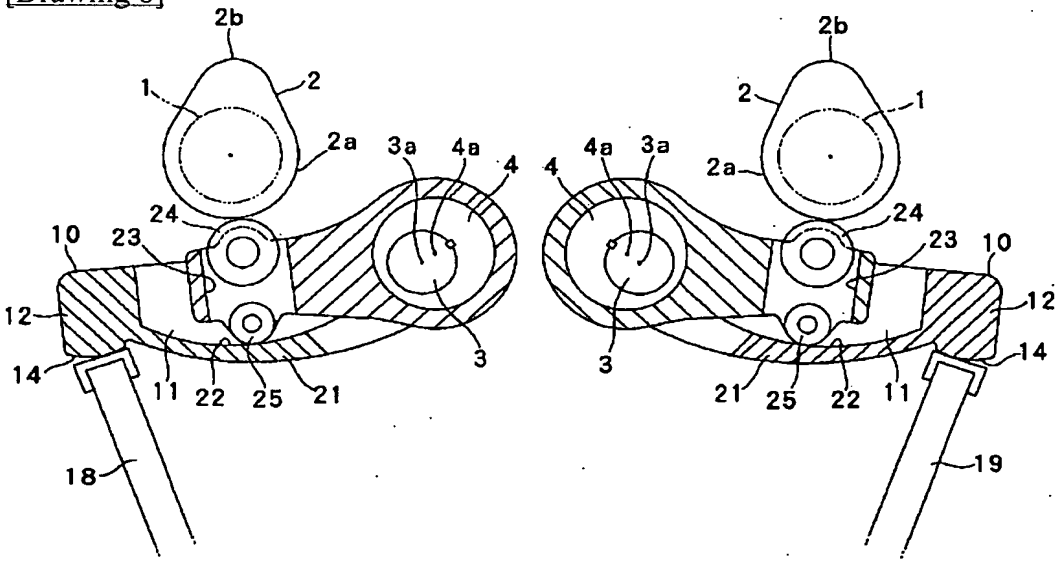

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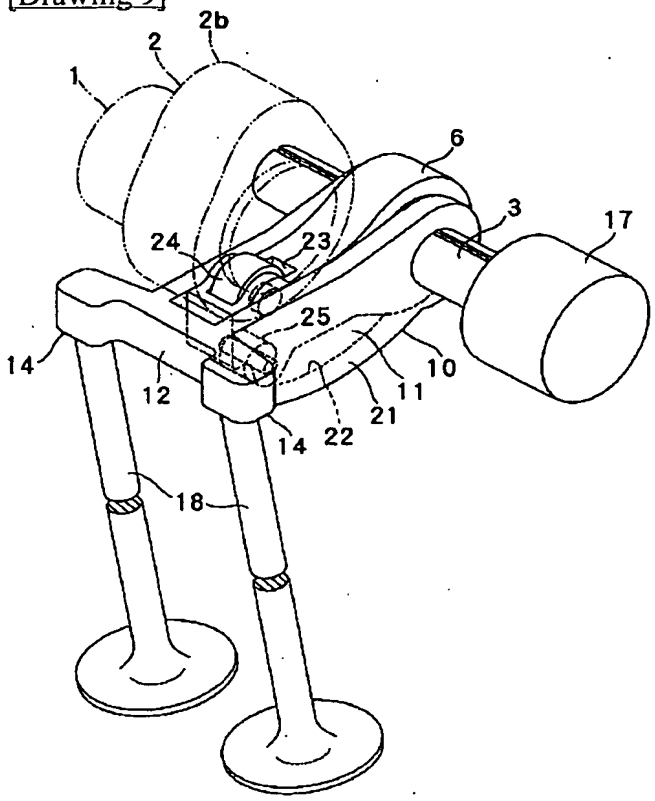

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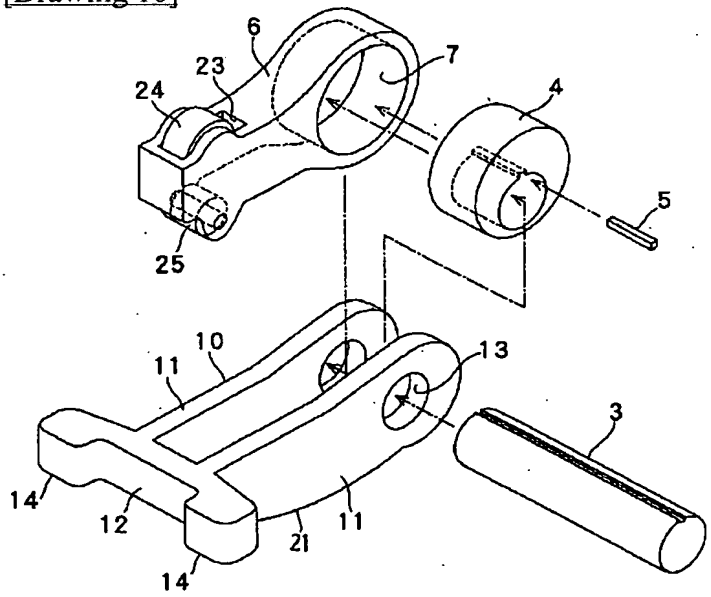

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